JET PROPULSION LABORATORY INTEROFFICE MEMORANDUM

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TO: **Sam Dallas**

FROM: **Jan Lyons** 264-214 x 31004

SUBJECT**: Fixed ΔV Sizes for Aerobraking.**

The following rationale is used to chose the fixed ΔV sizes for the maneuvers during aerobraking. The smallest maneuver size is 0.05 m/s based on a requirement from the spacecraft team. Except for AB-1, which is a more traditional maneuver computed just after MOI, the Walkin maneuver sizes were obtained by doubling the next smaller maneuver. The largest Walkin maneuver size was limited to 0.8 m/s (about 21 km periapsis altitude reduction for a 48 hour orbit). A maneuver size halfway between the 0.4 and 0.8 m/s sizes was selected to fill out the set of three sizes that are "pre-canned" for various aerobraking phases.

The Main Phase maneuver sizes were set equal to the maneuvers for the Walkin Phase. The smallest maneuver (0.05 m/s) is the most likely maneuver for the first half of the Main Phase. As the orbit shrinks and the maneuvers become less effective in terms of changing the altitude of periapsis, larger maneuvers become desirable to maintain a reasonable maneuver frequency. In the trajectory simulations, the largest maneuver size during the Main Phase is typically 0.4 m/s. Thus the largest three Walkin maneuvers sizes will be used for the latter part of the Main Phase.

The trajectory simulations show that a typical maneuver size during the Walkout phase required to maintain the 3 Day Orbit Lifetime Desirement with a One day maneuver frequency is about 1.1 m/s. Sometimes an 0.8 m/s maneuver is desirable for the first one or two walkout maneuvers. Doubling the expected Walkout size gives a 2.2 m/s maneuver, larger than any maneuver used in the simulations, but which might be used if the atmospheric density started to increase rapidly due to a dust storm. These three maneuvers (0.8, 1.1, 2.2 m/s) will be used for Walkout.

Table 1 gives the nominal maneuver sizes and the amount of Periapsis altitude change that is expected at various orbital periods. Table 2 shows when each size will be used.

CONCLUSIONS:

Because MGS will be operating in an unknown and poorly understood region of the atmosphere, I would prefer to have the flexibility to chose the maneuver size as part of the Maneuver Decision Process. The Fixed Maneuver Sizes given in Table 1 span the maneuver sizes that I have used in numerous simulations of the aerobraking phase, and represent my best estimate for the mimumum set of fixed maneuver sizes. The directions associated with these sizes changes as the argument of periapsis changes due to gravitational perturbations, so the number of precanned maneuvers will be larger than the number of maneuver sizes.

Table 1: Maneuver Sizes and Resulting Periapsis Altitude Change for various Periods.

ΔV	52 hr	48 hr	24 hr	12 hr	6 hr	3 hr	2 hr
0.05 m/s	1.4 km	1.3 km	0.85 km	0.55 km	0.36 km	0.25 km	0.21 km
0.10 m/s	2.8 km	2.7 km	1.7 km	1.1 km	0.73 km	0.50 km	0.42 km
0.20 m/s	5.6 km	5.3 km	3.4 km	2.2 km	1.5 km	1.0 km	0.84 km
0.40 m/s	11.2 km	10.6 km	6.8 km	4.4 km	2.9 km	2.0 km	1.7 km
0.60 m/s	16.8 km	15.9 km	10.2 km	6.6 km	4.4 km	3.0 km	2.5 km
0.80 m/s	22.3 km	21.2 km	13.6 km	8.8 km	5.8 km	4.0 km	3.4 km
1.10 m/s	30.7 km	29.2 km	18.7 km	12.1 km	8.0 km	5.5 km	4.6 km
2.20 m/s	61.4 km	58.3 km	37.4 km	24.2 km	16.0 km	11.1 km	9.2 km

Table 2: Aerobraking Phases Associated with Each Maneuver Size.

ΔV	WALKIN	EARLY MAIN	LATE MAIN	WALKOUT
0.05 m/s	YES	YES		
0.10 m/s	YES	YES		
0.20 m/s	YES	YES		
0.40 m/s	YES		YES	
0.60 m/s	YES		YES	
0.80 m/s	YES		YES	YES
1.10 m/s				YES
2.20 m/s				YES

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